

What is claimed is:

1. A pump for pumping blood through an extracorporeal circuit,  
comprising:

5 a housing having a wall with an exterior surface and an interior surface,  
the interior surface defining a pumping chamber;

a blood inlet and a blood outlet connected to the pumping chamber, the  
blood outlet including at least one duct between the interior surface and the  
exterior surface of the housing;

10 a blood inlet valve;

a blood outlet valve comprising flexible material having a peripheral  
edge affixed to the exterior surface and covering the at least one duct, the  
flexible material having at least one hole adjacent the exterior surface and  
spaced from the at least one duct; and

15 means for moving the blood into the pumping chamber through the inlet  
and out of the pumping chamber through the outlet.

2. The pump of claim 1 wherein the pumping chamber is substantially  
cylindrical.

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3. The pump of claim 1 wherein the at least one duct is a plurality of ducts.

4. The pump of claim 3 wherein the ducts are arranged radially.

25 5. The pump of claim 3 wherein each duct of the plurality of ducts is  
evenly spaced.

6. The pump of claim 1 wherein the blood inlet valve comprises a flexible  
membrane.

7. A pump for pumping blood through an extracorporeal circuit,  
comprising:

a housing having a wall with an exterior surface and an interior surface,  
5 the interior surface defining a pumping chamber;  
a flexible membrane having a peripheral edge secured within the  
pumping chamber, the membrane dividing the pumping chamber into a first  
side and a second side;

a blood inlet and a blood outlet connected to the first side of the  
10 pumping chamber, the blood inlet including at least one duct between the  
interior surface and the exterior surface of the housing;

a blood inlet valve; and

a blood outlet valve having a flexible section with a peripheral edge  
affixed to the exterior surface and covering the at least one duct, the flexible  
15 section having at least one hole adjacent the exterior surface and spaced from  
the at least one duct.

8. The pump of claim 7 wherein the pumping chamber is substantially  
cylindrical.

9. The pump of claim 7 wherein the at least one duct is a plurality of ducts.

10. The pump of claim 9 wherein the ducts are arranged radially.

11. The pump of claim 7 wherein each duct of the plurality of ducts is  
evenly spaced.

12. The pump of claim 7 wherein the blood inlet valve comprises a flexible  
membrane.

13. A pump for pumping blood through an extracorporeal circuit, comprising:

a housing including a first portion and a second portion, the first portion  
5 having a wall with a first interior surface and a first exterior surface, the second portion having a wall with a second interior surface and a second exterior surface, the first and second portions being positioned such that the first and second interior surfaces define a pumping chamber;

a flexible membrane positioned in the pumping chamber, the membrane  
10 having a peripheral edge which is affixed between the first and second portions of the housing, the membrane dividing the pumping chamber into a first side adjacent the first interior surface and a second side adjacent the second interior surface;

a blood inlet connected to the first side of the pumping chamber;

15 a blood inlet valve for controlling the flow of blood through the blood inlet;

a blood outlet connected to the first side of the pumping chamber, the blood outlet including at least one duct through the wall of the first portion; and

a blood outlet valve including a flexible portion having a peripheral edge  
20 affixed to the first exterior surface, the flexible portion having at least one hole adjacent the first exterior surface and spaced from the at least one duct, the outlet valve being configured such that the at least one duct is closed by the outlet valve in the presence of negative pressure in the pumping chamber and is open in the presence of positive pressure in the pumping chamber.

25 14. The pump of claim 13 wherein the pumping chamber is substantially cylindrical.

15. The pump of claim 13 wherein the at least one duct is a plurality of

ducts.

16. The pump of claim 15 wherein the ducts are arranged radially.

5 17. The pump of claim 15 wherein each duct of the plurality of ducts is evenly spaced.

18. The pump of claim 13 wherein the blood inlet valve comprises a flexible membrane.

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19. An integrated blood pump and oxygenator for use in an extracorporeal blood circuit comprising:

an oxygenator having a substantially cylindrical housing defining an oxygenation chamber containing a plurality of hollow fibers, the oxygenation chamber having a gas inlet and outlet communicating with the lumens of the hollow fibers and a blood inlet and outlet communicating with an exterior of the hollow fibers, the blood inlet including a substantially continuous circumferential opening in the oxygenation chamber; and

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a blood pump having a housing having a wall with an exterior surface and an interior surface, the interior surface defining a pumping chamber; a flexible membrane having a peripheral edge secured within the pumping chamber, the membrane dividing the pumping chamber into a first side and a second side;

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a blood inlet and a blood outlet, the blood outlet including a plurality of ducts between the interior surface and the exterior surface of the housing;

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a blood inlet valve; and

a blood outlet valve having a flexible section with a peripheral edge affixed to the exterior surface and covering the plurality of ducts, the flexible section having at least one hole adjacent the exterior surface and spaced from

the plurality of ducts, the blood outlet of the pump being connected to the blood inlet of the oxygenator, the ducts being spaced radially such that during use blood is uniformly distributed among the hollow fibers.

5 20. The integrated blood pump and oxygenator of claim 19 wherein each duct of the plurality of ducts is evenly spaced.

21. The integrated blood pump and oxygenator of claim 19 wherein the blood inlet valve comprises a flexible membrane.

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